

Complete shell within 14 working days

House with new concrete technology and an improved construction with precast elements

The use of high-quality concrete building materials and systems complements the short assembly times using precast elements of concrete and lightweight concrete, creating an economic, and forward look-

ing method of building. The Readymix building materials group proves this again, with the shell of a house in Hagen.

During a construction period that scarcely lasted three weeks, the Ratingen based company invited architects and designers on site, to show them the production of a waterproof basement, designated the "Orange Tank", a foundation plate made of Aaton steel fibre and the assembly of wall and floor elements executed using very different methods.

around of 190 m², 100 m² of basement and two garages. The owner, who himself works in the industry, decided on a complete shell built from precast elements. In this case Readymix not only supplied building materials and elements, but also managed the construction of the "complete house" shell from design to build and the issuing of the guarantee.

ing had, as far as possible, to be built in rocky ground, which was below adjacent higher land that was partly used as a meadow for grazing cattle. In order to prevent any damp penetration into the basement, the owner gave the Ratingen building materials group the task of building a waterproof basement using new concrete sealing methods. Encouraged by the company colour, the firm calls this type of basement an "Orange Wanne" [Orange Tank]. However in practice it does not differ in colour from any other concrete elements. The "Orange Tank" service package includes the design of the sealing method, the associated special products such as Aaton and steel fibre reinforced concrete as well as the management of the build, all from one supplier. For this, these concrete specialist guarantees the waterproofing of a basement built this way for ten years, five years longer than usually offered under German regulations.

The "complete house" - everything from one supplier

Starting point was a sloping property on the edge of Berchum, a quarter in Hagen, where the owners, a married couple both born in Hagen, wanted to erect a house with a living area of

In order to make use of the sloping position, a smaller garage was to be erected at ground floor level on the upper part of the property next to the main building, which has a full sized basement. Another garage, accessible from the basement, was to be built on the lower part of the property, with a greened roof. The build-

Base plate of Aaton steel fibre

On the building site the Orange Tank is constructed in two sections, the laying of the base plate and the assembly of the walls. The base plate consists of lightly compacted concrete Aaton aqua with steel fibres and combination reinforcing. With a slump of a ≥ 630 mm, Aaton aqua is very fluid and therefore ideal for waterproof construction elements. The high self-compaction also prevents the penetration of additional air in critical places, so the chute height should be kept as low as possible. For making the Orange Tank the Aaton aqua is combined with the advantages offered by steel fibre reinforced concrete. Compared to reinforced concrete with conventional mesh reinforcements, steel fibre con-



Base plate from Aaton steel fibre - preparations and pouring the concrete for the base plate were completed in only two days



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crete exhibits considerably better tear behaviour under residual or external stresses – in this case there is a substantial force involved in keeping the basement waterproof. By making the process much easier, for example no blinding layer is necessary, faster progress is made in building and there is less danger of bad workmanship. When used in combination with conventional mesh reinforcements, in an area with water pressure and to limit crack width, the steel fibre proportion can be calculated such that the mesh reinforcements can be dimensioned substantially smaller. On the Hagen building site it took only two days to complete the preparations and pouring of the concrete base plate, which was delivered by a concrete mixer truck, ready mixed and just in time.

Orange Tank – made with precast units

The principle of the Orange Tank is to provide for the sealing of the gaps between one element and the next, i.e. the horizontal joints and the vertical cracks or construction joints, with a expanded metal joint positioned in the centre. So, before pouring the concrete base plate, a 3 mm thick and approx. 17 cm high “Pentaflex” metal sealer from the South German company H-Bau Technik GmbH was inserted to a minimum depth of 3 cm. The

double wall elements, whose outer and inner concrete shells are bound with lattice girders, are fixed centrally over the sheet metal joint in such a way that the gap can be filled without moving the sheet metal.

Assembling the double wall elements for external walls and solid walls for the internal area was completed within six hours. As an architect stated on his second inspection: “No further drainage and no further painting with bitumen is necessary as in the case of the ‘black tank’ and, had a normal building company been given the job, it is better than the ‘white tank’ because of the neutral supervision of the build - and all that with a guarantee, simply super!” A colleague added that they would probably have to get involved with the waterproof basements as a standard item, because in the future the new waterproofing guideline will have to be used in buildings where only soil water is present, which will be classified as requiring a waterproof basement.

The concreting over of the double wall elements in the basement and making the floor above it took place on another working day. After first the supports and horizontal props had been erected, the double wall elements are filled with a ready-mix concrete of strength class C 25/30. A

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small grain size is necessary to achieve the maximum compaction without aeration. The sheet metal joints had previously been positioned into all the vertical element joints and corners in the double walls.

Large floor elements

Just like the floor above the ground floor, the 5 cm thick filigree floor over the basement consists of large elements with reinforcement incorporated at the factory. After the precise assembly of the large elements, that are at a maximum 2.50 m x 10.00m, the floor is filled with ready-mix concrete in C 25/30 grade. Due to the good, statically variable properties of this type of floor, it is only

18cm thick despite comparatively large spans and that on some parts of the floor, walls rest in the middle. The ceiling elements only rest upon the interior shell of the double wall elements. The outer shell is built higher to save constructing manual shuttering.

Betonwerke Werth GmbH in Lahntal and Bremke supplied all wall and floor elements, together with special construction components like the spiral staircase. As a Readymix subsidiary and part of the Lösch group created at the beginning of 2004, they are responsible for the design and build of the Orange Tank and the Aaton base plate. The final façade has a tile lining, applied on 16 cm thick insulation.

Solid walls

Two days after the concrete floor has set, within four hours all external and internal walls in the ground floor have been installed. The architects and designers that accepted the invitation to the fourth building site visit, again were able to observe the sophisticated logistics of the assembly, which has similarities with a modular construction method. The conduits for the electrical cables had previously been installed according to a well thought through plan, with recesses for the pipes and a defined maximum element size. Now the assembly of the precast elements ran like clockwork. As they were delivered upright, they could be installed in the desired order: Take the element by crane off the low loader, put mortar for the walls on the marked lines, position the element over the relevant bed of mortar, align against angles screwed on the floor, drop down onto the spacers, fix the element with inclined supports, align to the vertical, loosen off the crane ropes, joint - finished, next. Finally fix the grouting chambers, which are fitted with steel loops, through a reinforcing iron in the wall, and pour with grouting concrete.

A build that saves time and costs

Werth construction supervisor Dirk Schinke, who was responsible both for the calculations and the build of the entire shell, has already been involved in about 25 houses of this kind this year: "In this case we have all used a lightweight concrete construction with solid walls and expanded shale, as for a two-person household more sound insulation was not necessary". Michael Saphörster, area manager and deputy managing director at Werth, underlined the advantages for the owner: "When money is limited, we can supply with our complete house, made possible because we as a building materials group can cross-sell internally, providing all products and services needed for the shell. The owner gets proven quality and saves time and money. So for him he can "Build with security" in two senses". Saphörster attaches importance to cooperating with building companies: "The Orange Tank build can be done by trained building contractors. The design and practical on site ma-



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which the design department coordinated individually with production and the carpenter.

Following the completion of the sell, the owner believes that his decision was the right one: "Not only was a short time needed to build the shell, but the precast element construction had positive effects on subsequent work done by other trades: The windows can be built parallel due to the predetermined openings. The fixtures for the electrical cables were already built in. With good preliminary planning everything fits together perfectly, quickly and economically. That is the building method of the future!" ■

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The complete house of Betonwerke Werth: Build with security

agement is in the hands of Ready-mix, in order to be able to give a ten-year guarantee. Werth has the specialists for the production of precast concrete elements, whereas assembly can be done by the building contractor, or if necessary with support from a service engineer".

During concreting the floor above the ground floor, which takes place on the following day, difficult details were solved, such as attaching four thermally separated balconies made of fair-faced concrete or 45° angles. The owner commented: "Once we had been convinced of the possibilities of the concrete and the precast construction, we did not restrict ourselves when it came to the design".

In the design of the top floor the design engineers had to consider issues relating to transport and manufacturing. As the walls than run up to the gable were over the maximum 3.85 m possible with the deep-bed special transport, these elements were produced in the concrete plant lengthwise on the large steel tables, around 3.00 m x 9.50 m. The gable elements with a width of over 3.00m were extended in height with separately manufactured gable triangles on the left and right of the ridge beam. All the re-

cesses for the purlins of the timber roof had to be planned for. Where necessary the top of the solid walls was modified in its thickness to fit the 30° inclination of the roof. A particular challenge was the intersection of the two dormers with the gabled roof,



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